MAKING A SHEET-STEEL MITER-BOX IN THE PUNCH PRESS

SOME INTERESTING PUNCHES AND DIES USED IN PRODUCING MITER-BOXES FROM SIXTEEN-GAGE SHEET STEEL

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Some excellent examples of die work obtained in the factory of the H. C. Marsh Co., Rockford, Ill., manufacturer of picture frame tools and miter-boxes, are shown in the accompanying illustrations. These views illustrate some of the most interesting punch press operations on the "Marsh-Ayer" pressed-steel miter-box, which is shown assembled and ready for use in Fig. 1. Every part of this miter-box, with the exception of the posts and an arch shaped forging beneath the table, are made from 16 gage (0.0625 inch thick) 20 point carbon sheet steel, which is known as a fine grade of deep drawing steel.

Not only does the production of this miter-box from sheet steel require the use of intricate dies and tools, but it also demands the aid of a punch press capable of producing the parts on a manufacturing basis. Although the idea is still held by many that the punch press is only suitable for light sheet-metal work, and is not capable of heavy sheet-steel forming, nevertheless, wonderful strides have been made in the past few years in the design of punch presses adaptable to the manufacture of many parts from heavy sheet steel. The production of this miter-box from sheet steel 0.0625 inch thick in a punch press of the type shown in Fig. 3, should be conclusive proof that the punch press of present-day design can be classed as a manufacturing machine.

Press Operations on the Miter-box Frame

The frame of the miter-box, some of the press operations on which are illustrated in Fig. 2, is the most difficult part to produce, and is the one that requires the greatest amount of power. The frame is first cut to blank form, as shown at *A*, and is then drawn up into box form. In its finished shape, it is 18⅝ inches long by 4½ inches wide and 1¼ inch deep (this latter dimension is the finished height, from 1/16 to ⅛ inch being allowed for milling). This difficult drawing operation on the frame, as well as all the operations on the other parts of the miter-box, is accomplished in a No. 4 Rockford geared punch press, shown in Fig. 3, which is operated at 45 revolutions per minute, and at this speed is capable of exerting a pressure of 60 tons per square inch.

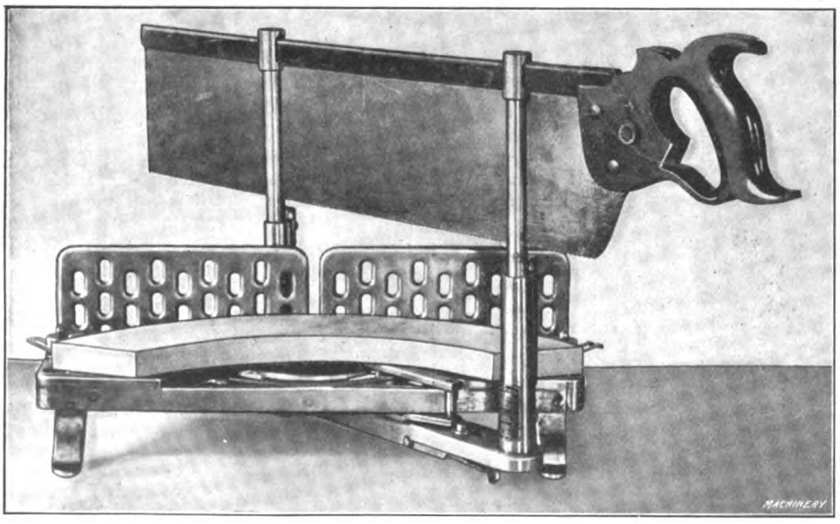

Fig. 1. Sheet-steel Miter-box produced in the Punch Press

The blank for the miter-box frame, which is shown at *A* in Fig. 2, is much longer than the bed of the punch press, so that a special bolster has to be provided, and in this is inserted a pan for catching the blanks as they are cut out. The pan is made deep enough to hold three blanks, and is removed from under the die when this number is cut out. There are, in all, fourteen punch press operations required to produce the frame of the miter-box. Briefly, they are as follows: Blanking (see *A*, Fig. 2); center drawing; embossing (see *B*, Fig. 2); graduating; stamping figures; drawing up into box shape (see *C*, Fig. 2 and also Fig. 3, which shows the operation being performed); center perforating (see *D*, Fig. 2); center drawing; perforating, two operations. Only one-half of the frame is perforated at a time, the same punch and die being used for each end, and the frame being reversed end for end. After perforating the holes in the two end portions of the frame, they are drawn up, one-half the number of holes being drawn at a time and the frame being reversed as before mentioned. The type of drawing die used is similar in construction to that shown in Fig. 7. The final operation is the embossing of the two ends; this requires two operations in the same die, one end being done at a time.

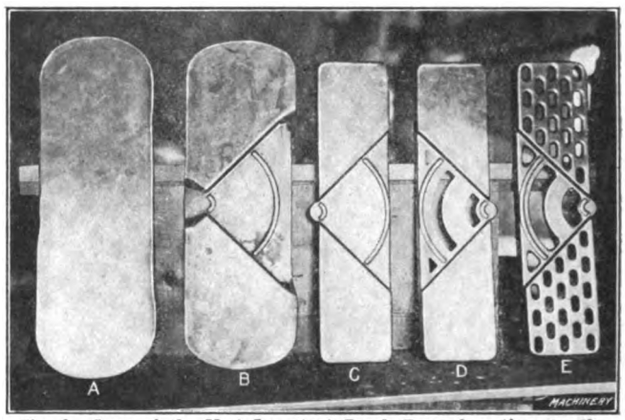

Fig. 2. Some of the Most Important Punch Press Operations on the Frame of the Sheet-steel Miter-box shown in Fig. 1

Graduating and Stamping the Frame

After the center portion of the frame has been drawn up and embossed so that it is in the condition shown at *B* in Fig. 2 (which operations are performed with tools of comparatively simple construction), the next operation is to graduate the center portion. The graduations are made on an arc of a circle, so that any angular movement of the saw guide can be obtained in degrees for any setting within an angle of 90 degrees. These graduations are stamped in the frame in the punch press shown in Fig. 3, by a die which has V-projections of the required length formed on its top face. The other member of the die (or punch) is perfectly smooth, and is only used for pressing the graduations into the frame. The tool used for stamping the figures is shaped somewhat like a regular punch-holder, and is held in the ram of the press. This holder carries, or has inserted in it, the required number of stamps which are of a similar type to those used when stamping by hand, and are held in place in the holder by set-screws. The lower member of this stamping tool is also left smooth, and is provided with guides to locate the work properly.

Drawing up the Sides of the Frame

The drawing up of the sides of the frame is a difficult operation because of its irregular shape, its size, and the height to which the sides are drawn. Fig. 3 shows the tools used for drawing up the sides of the frame set up in a No. 4 Rockford geared press, and gives some idea of the enormous power required for this operation. As can be seen, the die projects a considerable distance past the frame of the press. The drawing die *A* is held on a special bolster *B*, which is bolted to the bed of the press. The work after being drawn is ejected from the lower die by a spring pad which bottoms in a recess in the die shoe, when forced down by the work and upper member of the die, or punch.

The drawing punch is fastened to a large punch-holder *D*, which is held to the ram of the punch press and is provided with two protecting arms, not shown. These arms act as

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stops for the heavy springs *C* which furnish pressure to the pressure pad *E*, the function of which is to prevent the stock from wrinkling while the deep vertical flange around the edges of the frame is being drawn. It will be noticed that the pressure pad is cut away on its lower face to clear the embossed center portion of the frame, which has been accomplished in a previous operation. The drawing punch is also cut away in a similar manner. The accomplishment of this difficult operation in a press of this size speaks favorably for the high-duty punch presses built by the Rockford Iron Works, Rockford, Ill., and demonstrates in a remarkable manner the manufacturing capabilities of these machines.

Drawing up the Edges of the Perforations in the Frame

After the sides of the frame have been drawn up, the center portion is perforated in several places as shown at *D* in Fig. 2. Then the edges of these perforations are drawn up about ¼ inch to increase the strength of the frame. This operation is accomplished with the tools shown in Fig. 4. Here *A* is the punch-holder which is held to the bolster of the punch press in the usual manner, and is provided with hardened and

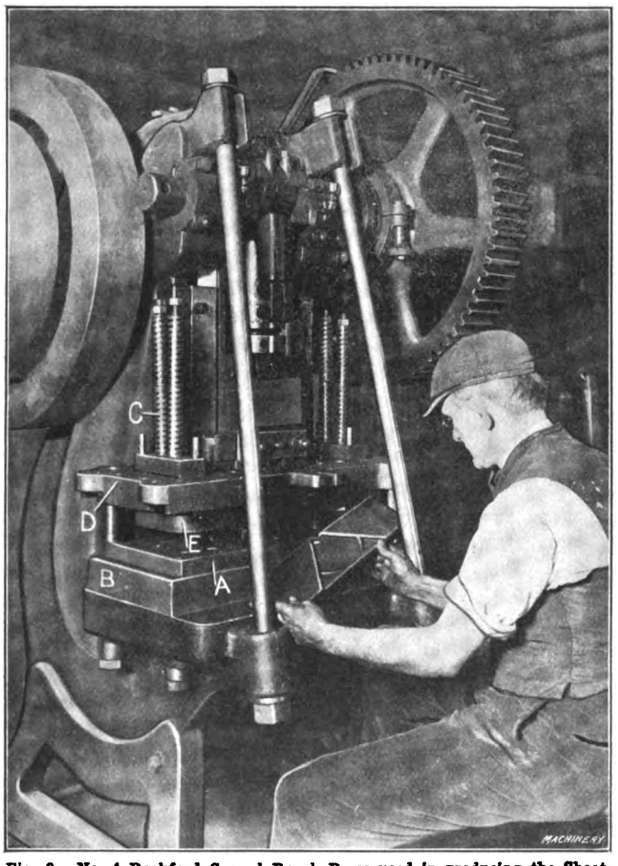

Fig. 3. No. 4 Rockford Geared Punch Press used in producing the Sheet-steel Miter-box shown in Fig. 1, set-up for drawing up the Sides of the Frame

ground pilot pins *a* which locate and guide the drawing die *B*. The drawing punches *b*, which are fastened by screws to the punch-holder *A*, are surrounded by a floating pad *c*, the function of which is to keep the top surface of the stock perfectly flat while the edges of the perforations are being drawn. The drawing punches *b* are, of course, made smaller than the irregular shaped holes in the drawing die to allow for the thickness of the metal. The holder carrying the drawing die *d* is fastened to the ram of the press by the shank, which is not shown in the illustration.

In operation, the frame is laid on the punch *A* and is located by depressions in the floating pad *c* which fit the embossed center portions of the frame. As the press is operated, the die *d* descends and as soon as it touches the blank it holds the latter firmly against the floating pad which prevents the work from bending while the punches are forcing the edges of the perforations into the die impressions. These tools, when made, were intended to draw up the edges of oblong-shaped holes to be cut in the arch shaped strip *e* (see finished frame resting on top of tools), but were discarded when it was found that the frame was rigid enough without this additional drawing operation. The completed frame is shown at *E* in Fig. 2.

Making Miter-box Legs

The legs for the miter-box shown in Fig. 1 are also made from 0.0625 inch, 20 point carbon deep-drawing sheet steel, and are completed in three operations in the punch press. The first operation, shown at *A* in Fig. 6, consists in cutting out a blank of the required shape; this operation is accomplished with a simple blanking punch and die. The next operation, shown at *B*, is the first drawing operation and consists in turning up the two sides of the blank. The work when being drawn is not forced through the die, but is ejected

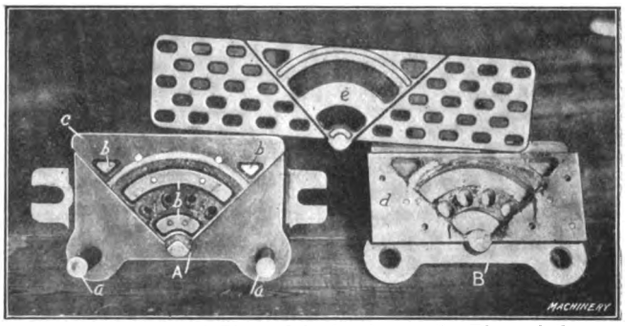

Fig. 4. Punch and Die used in drawing up the Edges of the Perforations in the Center of the Miter-box Frame

by means of a spring pad inserted in the die and bottoming in a recess in the die shoe, when the ram is at the lowest point of its stroke.

The next operation on the miter-box legs, which is the most interesting, consists of the final drawing to shape. The result of this operation is shown at *C* in Fig. 6, and also at *b* in Fig. 5, where the tools used are also shown. The conditions met with in the production of this piece are unusual, in that the depth of the draw is 2 11/16 inches, and the height of the blank 11/16 inch, making a total of 3⅜ inches, whereas the stroke of the punch press used is only 3½ inches. It is evident, therefore, that there is a clearance of only ⅛ inch between the punch and the blank when the ram of the punch press is at the highest point of its stroke. This, added to the irregular shape of the work, made it extremely difficult to remove the finish-formed leg from the die. It was only possible to do so by cutting away the front wall *c* of the die, shown at *A* in Fig. 5, and by using a cam-operated stripper *d* to pull the work from the punch *e*. A knock-out was added for this pur-

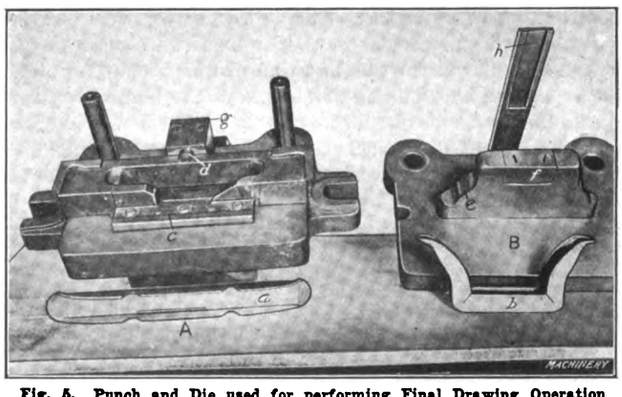

Fig. 5. Punch and Die used for performing Final Drawing Operation on Legs of Miter-box shown in Fig. 1

pose, but as it projected below the ⅛-inch allowable clearance, when the ram of the punch press was at the extreme height of its stroke, it had to be abandoned. The block *f* which is set into the punch shows the position of this knock-out as originally used.

Referring to the drawing die used for the leg, which is shown at *A* in Fig. 5, it will be noticed that the lower face of the die block projects past the lower face of the bolster. This was found necessary to give sufficient clearance for getting the blank into and out of the die, as it is evident that thickening the bolster sufficiently to give the required depth would have raised it too much above the top surface of the bed of the punch press. The stripper *d*, which consists of a flattened

plunger held inward by a coil spring located in the block *g*, is operated by the strip *h* attached to the punch-holder *B*. The blank shown at *a* is located in the correct relation to the punch and die when being drawn, by a milled impression on the top face of the die bolster.

Punch and Die for Drawing up Edges of Perforations in Rear Guide Plates for Miter-box

The back of the miter-box, as shown in Fig. 1, consists of two perforated and embossed plates, which are also made from 1/16-inch sheet steel in the punch press. The punch and die used in drawing up the edges of the perforations in these plates are shown at *A* and *B* in Fig. 7, a completed rear guide being shown at *C*. Before these plates are ready for the final

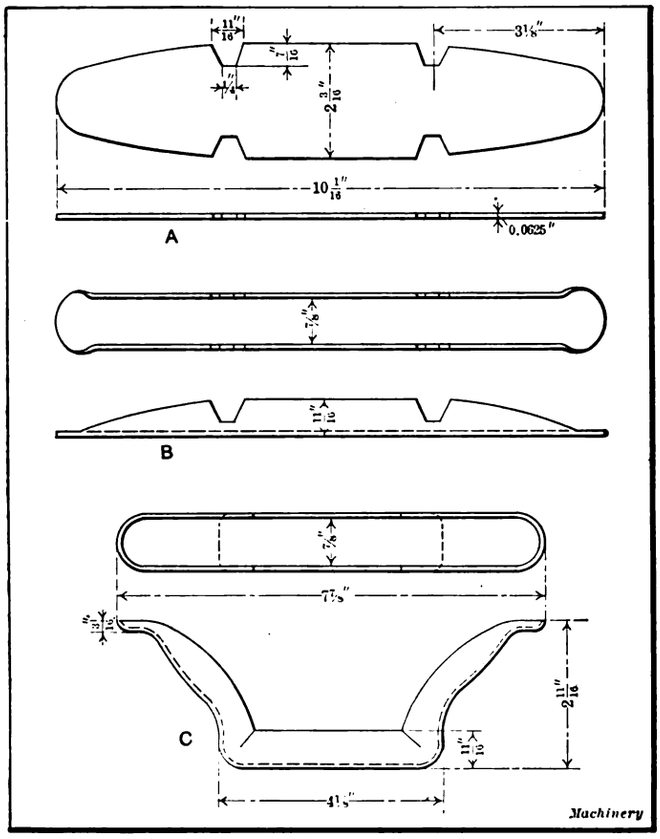

Fig. 6. Illustration showing Sequence of Punch Press Operations on Miter-box Legs

operation—drawing up the edges of the perforations—several operations are performed on them. The first operation consists in cutting out the blanks in an ordinary blanking punch and die. Then the top and side edges of the blank are drawn up, the die used for this purpose being provided with a spring pad for ejecting the work, which is not forced through the die. Following this operation, the holes are pierced, thus preparing the blank for the final operation.

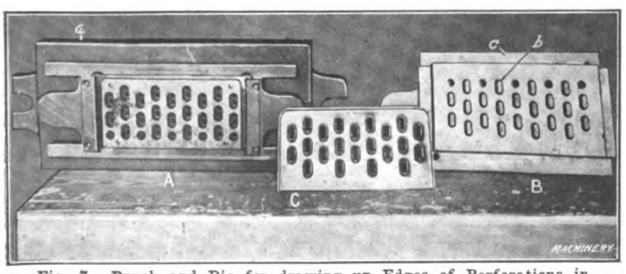

Fig. 7. Punch and Die for drawing up Edges of Perforations in Rear Guide Plates

The drawing die used in drawing up the edges of the perforated holes, as shown at *A* in Fig. 7, also acts as a guide for the blank, locating the latter from the turned up edges. The punches *b*, as was the case with those shown in Fig. 4, are surrounded by a floating pressure pad *c* which keeps the blank straight when the edges of the perforations are being drawn and also assists in stripping the work from the punches. All the perforations in the various members of the miter-box are drawn up to a height of about $\frac{1}{4}$ inch from the opposite face of the blank. The object in making these "embossed" perforations, of course, is to strengthen the frame and thus permit it to be made from comparatively thin material. Those familiar with this class of work know that embossing and perforating the material in the manner shown makes it very stiff in comparison with flat plates of the same material. The appearance is also greatly improved by the addition of these apparently expensive operations. On the other hand, while it is possible to carry on these operations successfully in the punch press, it would be difficult to produce a miter-box from material of sufficient thickness to give the same strength, if the embossing operations were not performed.

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